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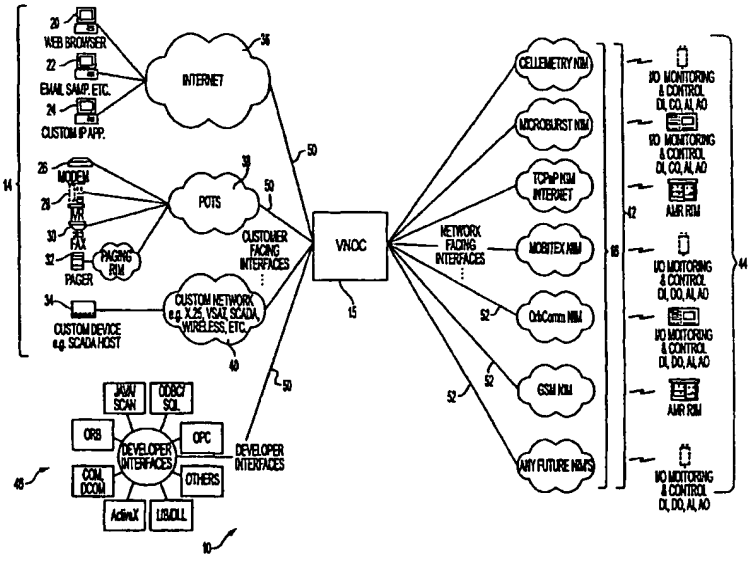

(57) Abstract: The invention mediates between a fixed or mobile remote asset or resource (44) and a network-facing interface (16) for telemetry applications. For instance, vending machines or other electronic devices may be monitored for stocking, power faults and other operation. Wired or wireless interfaces to those remote machines (44) may report their operational condition to a server which translates the status information into a streamlined format, for instance via a Web page for login and viewing. Convenience and interoperability are enhanced.

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SYSTEM AND METHOD FOR A VIRTUAL NETWORK OPERATIONS CENTER

Field of the Invention

The invention relates to a virtual network operations center which allows operators using customer interfaces to communicate with remote network-related interfaces.

Background of the Invention

Telemetry, remote control, and remote monitoring and management applications are becoming increasingly complex and widespread. Typically, telemetry technology is used to monitor and/or control devices which are remote from the user. For example, telemetry technology may be used to monitor remotely located meters (*e.g.*, fuel tank gauges, electric power meters etc.), vending machines, credit card readers, alarm systems, and other devices. As the applications become widespread, more customers are exposed to the technology. Often, these customers are not familiar with the technological intricacies and become frustrated or discouraged when attempting to manipulate the interfaces of existing systems.

Existing telemetry and remote monitoring networks utilize numerous platforms to accomplish their respective applications. For example, existing telemetry and remote monitoring and control networks may operate over RF, cellular, microwave, satellite, IP or other transmission media and network protocols. Each transmission network has characteristics which influence the nature of the hardware needed to implement the system. Thus, customers can be exposed to a wide variety of hardware platforms which may unduly complicate their use of such telemetry systems.

Existing remote monitoring systems transmit acquired data to a central location, either over hardwired landlines or by broadcasting the data. The data transmission capability of each system depends on the medium of transmission available at that location. Existing remote monitoring systems thus require pre-selection of the desired transmission medium for the system before manufacture or installation so the appropriate communication equipment can be included. This limits the flexibility of existing remote monitoring systems.

These and other drawbacks exist.

Summary of the Invention

An object of the invention is to overcome these and other drawbacks in existing devices.

Another object is to provide telemetry, remote control and monitoring customers a virtual network operations center (VNOC) system which insulates the customers from the intricacies of transporting data across different networks.

Another object is to provide a VNOC system which relieves the customer from the need to operate, maintain, or update the system.

Another object is to provide a VNOC system which allows one-to-one, one-to-many, many-to-one, and many-to-many type connections between users and remote monitoring points.

Another object is to provide a VNOC system for which messages may be of a wide variety of sizes and types.

In general, according to the invention a VNOC system monitors and communicates the occurrence of events. Events may include discrete data representing something that happened, or did not happen, at a location or time. Events may also include initiation or receipt of data representing a message or file (*e.g.*, point-to-point messaging or file transfer). Events may be collected from an Input/Output (I/O) device, users, or other peripheral devices. Events may be classified as inbound or outbound. An inbound event denotes a communication from an I/O point, user or other peripheral device to the VNOC and subsequently to a terminal device. An outbound event denotes a communication from the VNOC to an I/O point, user or other peripheral device and generally may be used for

feedback and monitoring control. I/O points generally include an input/output device with monitoring, collection and feedback of event data.

Accordingly, the invention relates in part to a VNOC architecture to meet the growing and dynamic needs of telemetry, control and monitoring (*e.g.*, Supervisory Control and Data Acquisition (SCADA)), and point-to-point information service customers. Specifically, the VNOC system according to the invention refers to a reliable, computer-implemented service in which customers can homogeneously interact with their input/output (I/O) points, mobile data and communication devices, computers or other client devices without having to deal with proprietary physical, network, transport, or other protocols. The VNOC system according to the invention manages the requirements and idiosyncrasies of the protocols used to accomplish telemetry and remote monitoring and control. In addition, the VNOC system according to the invention provides customers with a consistent and integrated conduit to interact with their I/O points, mobile data and communication devices, computers and other clients, networks, databases, developer interfaces, printers, facsimile equipment and other output devices, and other assets or resources.

These interfaces are powerful and flexible enough to satisfy the needs of the most demanding customers who may also want control of their systems. The VNOC system according to the invention may be implemented using multi-redundant servers, multi-redundant connections, and multiple locations to enable

high availability and reliability according to customer demand. Different I/O points, hand held devices, computers or the like may be implemented using different media and networks for connectivity. Physical media, network topologies, third party service providers, other system elements and combinations thereof may be chosen to provide the best cost per performance point according to customer demand. Existing wireless technologies and platforms such as Cellemetry™, Aeris MicroBurst™, Mobitex™, OrbComm™, Global System for Messaging (GSM), CDMA (Code Division Multiple Access), TDMA (Time Division Multiple Access) Global Positioning System (GPS), Bluetooth, IEEE 802.11b-standard wireless LAN, HyperLAN II and others may be used. Satellite links such as those offered by low Earth orbit (LEO) or geosynchronous Earth orbit (LEO) platforms may also be used. Wired technologies, buses and platforms such as ModBus™, VMEBus™, General Purpose Interface Bus (GPIB), RS-232, Metrum-Datatape and others may be implemented to provide back-end network facing interfaces.

Front-end, customer facing interfaces are provided and may also implement the most prevalent and desired technologies, such as TCP/IP, hyper text transfer protocol (HTTP), Extensible Markup Language (XML), Wireless Application Protocol (WAP) or other data or Internet-related protocols, email, simple network management protocol (SNMP), interactive voice response (IVR), facsimile, paging, Research in Motion (RIM), dial-up or others. Furthermore, many customer facing interfaces are provided for development platforms used by customers. For

example, customer facing interfaces for development platforms such as Java Beans, ActiveX™ Controls, ODBC, Win32DLL, OLE for process controls, ORBs, D/COM, TCP/IP connections, and other platforms may be provided.

Brief Description of the Drawings

Figure 1 is a schematic representation of the system for an embodiment of the invention.

Figure 2 is a schematic representation of various events for an embodiment of the invention.

Figure 3 is a schematic representation of various transactions for an embodiment of the invention.

Figure 4 is a schematic representation of components of the system for an embodiment of the invention.

Figure 5A is a schematic of an embodiment of the architecture for an embodiment of the invention.

Figure 5B is a schematic of an embodiment of network architecture.

Figure 6 is a schematic of an embodiment of the invention employing redundant architecture.

Detailed Description of Preferred Embodiments

Typically, a VNOC system according to the invention is intended to provide seamless service for the customer monitoring or controlling remote resources or assets. For example, the following description of one embodiment of a VNOC system according to the invention is provided with reference to a remote water meter controller. The water metering customer has a remotely located water supply implementing a remotely controllable water metering valve. The customer desires to control the metering valve, monitor its status, and collect other data pertaining to the valve such as daily throughput, average water temperature, or other data. If a particular circumstance should occur, such as a drop in water flow below a predetermined level, the water valve meter may send a signal in whichever network format the remote controller implements, such as cellular, wireline, Internet, or other format.

The VNOC system of the invention provides the interface to receive data from the remote valve in that format and records the occurrence of an incoming event. The VNOC translates the incoming event into the outgoing event format or formats, which may be preselected by the customer. If the incoming event is one that the customer designated as requiring notification, the selected notification report is sent to the customer over the appropriate customer interface, such as facsimile, pager, email, instant messaging, telephone, cellular telephone, Personal Digital Assistant (PDA) or other channels.

If desired, the customer can take appropriate action through a customer interface. For example, the customer may send a command to the remote valve, such as open until the flow rate reaches a certain level. Such a command may be sent through the customer interface, such as inputting a code through a telephone tone/number sequence, inputting a command into a web browser, sequencing a code through a cellular phone or PDA, responding to screen icons or other elements, Interactive Voice Response (IVR) interfaces or other methods. The VNOC receives the command from the customer and may record another incoming event. The VNOC then translates the customer incoming event into the proper network outgoing event format and sends the command to the remote valve for implementation.

The above example is but one possible implementation of the VNOC. Additional applications and embodiments will be apparent from the following detailed description.

Figure 1 is a schematic representation of the overall system 10 according to the invention. VNOC system 15 is shown communicating between various customer interfaces 14 and network interfaces 16. Customer interfaces 14 may include any interface over which a customer may directly or indirectly communicate with the monitoring or control device. For example, customer interfaces 14 may comprise an Internet web browser 20, an electronic mail (email) interface 22, a custom Internet protocol (IP) application 24, a modem 26, an IVR

28, a facsimile machine 30, a pager 32, or some other custom device 34, such as control and monitoring (SCADA) host. Other customer interfaces 14 are possible. One or more of the various customer interfaces 14 may communicate with VNOC 15 over a communications link 50. For example, computer-related customer interfaces 14 such as web browser 20, email interface 22, or custom IP application 24 may communicate with VNOC 15 over a computer network 36.

The communications link 50 may be, include or interface to any one or more of, for instance, the Internet, an intranet, a PAN (Personal Area Network), a LAN (Local Area Network), a WAN (Wide Area Network) or a MAN (Metropolitan Area Network), a storage area network (SAN), a frame relay connection, an Advanced Intelligent Network (AIN) connection, a synchronous optical network (SONET) connection, a digital T1, T3, E1 or E3 line, Digital Data Service (DDS) connection, DSL (Digital Subscriber Line) connection, an Ethernet connection, an ISDN (Integrated Services Digital Network) line, a dial-up port such as a V.90, V.34 or V.34bis analog modem connection, a cable modem, an ATM (Asynchronous Transfer Mode) connection, or an FDDI (Fiber Distributed Data Interface) or CDDI (Copper Distributed Data Interface) connection. The communications link 50 may furthermore be, include or interface to any one or more of a WAP (Wireless Application Protocol) link, a GPRS (General Packet Radio Service) link, a GSM (Global System for Mobile Communication) link, a CDMA (Code Division Multiple Access) or TDMA (Time Division Multiple

Access) link such as a cellular phone channel, a GPS (Global Positioning System) link, CDPD (cellular digital packet data), a RIM (Research in Motion, Limited) duplex paging type device, a Bluetooth radio link, or an IEEE 802.11-based radio frequency link. The communications link 50 may yet further be, include or interface to any one or more of an RS-232 serial connection, an IEEE-1394 (Firewire) connection, a Fibre Channel connection, an IrDA (infrared) port, a SCSI (Small Computer Systems Interface) connection, a USB (Universal Serial Bus) connection or other wired or wireless, digital or analog interface or connection.

Thus, in addition to computer and data networks, telephone-related customer interfaces 14 such as modem 26, IVR 28, fax machine 30, pager 32 or others may communicate with VNOC 15 over a telephone network 38. Telephone network 38 may be wired or wireless. Custom devices 34 may communicate with VNOC 15 over a suitable custom network 40 such as X.25, VSAT, SCADA, wireless or others.

The various network-facing interfaces 16 may communicate with VNOC 15 over another communications link 52. That communications link may be or include a wire line, wireless, or other network or other communications resources similar to communications link 50. For example, the VNOC 15 may communicate with network-facing interfaces 16 over cellular, satellite, interconnected computer (*e.g.*, the Internet), or other networks. VNOC 15 may communicate over networks with various third party network services 42. For example, VNOC 15 may

communicate with third party network services 42 such as Cellemetry, MicroBurst, Mobitex, OrbComm, GSM, and other platforms. The third party network services 42 may communicate with various I/O devices 44. The I/O devices 44 may enable monitoring and control of various systems. Monitoring and control may be implemented by any suitable input, output and protocol. For example, input and output may comprise digital, analog, AMR, or other signal formats.

Developer interfaces 46 may also communicate with VNOC 15. The developer interfaces 46 may be used by customers or others to enable other desired programs and applications. For example, developer tools such as Java/Bean, ODBC/SQL, OPC, LIB/DLL, ActiveX, COM, DCOM, ORB and others may be used to adapt telemetry applications in communication with VNOC 15.

As shown in Figure 2, the various customer and network interfaces may communicate the transmission of events through VNOC 15. Inbound events may originate at the customer interface (*e.g.*, inbound event 200), or the network interface (*e.g.*, inbound event 206). These inbound events may be processed into corresponding outbound events (*e.g.*, outbound events 204 and 202). As noted above, events may correspond to occurrences (or the lack of an occurrence) selected for customer monitoring. In other words, the events are situations for which the customer desires to be notified, based on preselected or dynamic criteria. Thus, events may comprise physical occurrences such as a meter recording a certain value, a pre-selected inventory item is shipped, etc. or other less tangible

occurrences such as when a pre-selected stock price is reached, a certain sales volume is reached, a particular email message is received, a particular time period has expired, a data file has been transferred, a point-to-point message is received, *etc.*.

For certain events a customer may desire notification. Such notification may comprise a report sent to the customer in a pre-selected format or formats for multiple reports. Other events may trigger other services. For example, some events may be set up to cause an automatic response from VNOC 15, for example, if a predetermined meter safety reading is exceeded, then automatically shut down the I/O device. Other services and network behaviors are possible. Reports and services associated with an event may be collectively considered as transactions. As shown in Figure 3, transactions may be inbound 300 or outbound 305. Such a configuration enables the reporting and processing of event data using a publish/subscribe paradigm. Reports and services triggered by an event may be handled as a single transaction.

Figure 4 is a schematic representation of internal structure of VNOC 15. VNOC manager 100 manages communication between customer interfaces 14 and network interfaces 16. Event manager 102 enables the management of events passing through VNOC 15. For example, events such as incharge, onset to offload, dependencies, concurrence, and others may be managed by event manager 102. Publication/subscription manager 104 enables the management of customer

subscription to, and network publication of events. Configuration manager 106 manages the configuration of various VNOC 15 components by enabling, for example, customer specification of interfaces, protocols, services and other criteria. Security manager 108 enables management of various security measures implemented in the VNOC system.

For example, security measures such as access rights, revocation, auditing, and other security functions may be managed by security manager 108. Error and recovery management manager 110 enables the management of error detection and recovery from errors. For example, error and recovery functions such as, notification, logging, recovery, backups, secondary paths, and other functions may be managed by error and recovery manager 110. Replication redundancy manager 112 enables various replication features. For example, redundancies between machines and locations, hot failure switchovers, persistence, rollovers, and other replication features may be managed by replication redundancy manager 112.

Customer billing module 114 enables, among other things, the tracking and billing of customer usage. For example, customer billing module 114 may manage the tracking of the level of usage, accumulation of bills, charges to third party interfaces, and other billing functions. Audit and log module 116 enables auditing and logging of various information. For example, location, levels, access, presentation, historical presence, and other information may be managed by audit and log module 116. Event naming module 118 manages the naming of events and

may communicate with event database 120. For example, using an extensible markup language (XML) style event naming.

Figures 5A and 5B represent an embodiment of the VNOC architecture. As shown in Figure 5A, the VNOC architecture compares with the open systems interconnection (OSI) reference model network architecture. The OSI reference model 550 provides for various layers of network architecture (as shown in Figure 5B). For example, the OSI layers may include a physical layer 1, a data link layer 2, a network layer 3, a transport layer 4, a session layer 5, a presentation layer 6 and an application layer 7. In an embodiment of the VNOC, physical layer 510 may comprise the various Ethernet, serial port, RF, modem, wireless, and other, physical connections as supported by the I/O device. Transport, network and data link layers 505 may comprise the various protocols that make up the network and customer interfaces (*e.g.*, WinSock, TCP/IP, IPX/SPX, UDP, SLIP/PPP, and other protocols). The session, presentation and application layers 500, comprise the various VNOC processes described herein.

The VNOC architecture according to the invention enables various features which provide for increased flexibility. For example, the VNOC system allows uniform representation of event data collected from a variety of I/O points, hand held devices, computers and networks. In addition, the reporting and receipt verification of events can be provided in any available customer protocol and interface. The symmetric design also provides for the customer to be an I/O point

and provide an incoming event into VNOC 15. The VNOC architecture may allow one user to connect to one point (one-to-one), to multiple I/O points, hand held devices or computers (one-to-many), multiple users to connect to one I/O point, hand held device or computer (many-to-one) and multiple users to connect to multiple I/O points, hand held devices or computers (many-to-many).

Additional features of the VNOC according to the invention exist. For example, users may be provided with simple and flexible interfaces, which they are accustomed to, and over which they can interact with their I/O points for feedback and control purposes. Furthermore, the VNOC may allow users to query the system to retrieve desired data. Additionally, the VNOC may provide the ability to summarize data at user specified level of detail and for user specified periods of time.

Figure 6 represents a schematic of an embodiment of a VNOC system according to the invention. As shown, such an embodiment enables high availability of the VNOC by providing multi-redundant systems (*e.g.*, VNOC 15A, VNOC 15B, and VNOC 15C). Other multi-redundant features (*e.g.*, multi-redundant servers, connections, and geographic locations) also ensure reliability and availability of the VNOC system.

The VNOC remote monitoring system of the invention may be combined with other technologies to provide more sophisticated notification and/or data collection systems. For example, two-way pager notification can be employed as

an add-on to the system. Also, integrated voice response can be employed in the system to enable the system to confirm that a particular notification has, in fact, been received by the proper personnel. Other features, such as fax on demand and web presence, can be employed to provide periodic information updates via fax or Internet.

This feature is particularly useful when a data collection center is collecting data from a plurality of remote monitoring systems and compiling the data for analysis purposes. A variety of other technologies may be interfaced with the remote monitoring system of the invention to allow customization of each product to the user's needs. For instance, the system can be adapted for security monitoring and reporting applications to use, for example, the Mobitex PCS network for the transmission of video capture of intrusions or status of monitored area.

The invention may be employed in a variety of different applications which are suited for remote monitoring. For example, in addition to monitoring devices such as water flow meters and aerial tower lights, the invention may be employed to monitor devices such as vending machines, drop boxes, sewer and water treatment facilities, flood control systems, generators, switch gear, gate access, railroad systems, waste management systems, environmental management systems, oil and gas pipelines, downhole well data analysis, well head monitoring, traffic systems, electric, gas and water utility systems, medical alert systems, or the

invention may be employed as part of a quality management system. Other applications of the invention will be apparent to persons skilled in the art.

The invention may be employed for the remote monitoring of vending machines such as food or beverage dispensing machines. For example, a remote monitoring system can be installed in or near a vending machine and connected to appropriate sensors to monitor such characteristics as power status, product inventory, available monetary change status and a variety of general dispensing functions to ensure that the vending machine is operating properly at all times. Sensors may be any conventional system for acquiring the type of data which is to be monitored. For example, many vending machines include electronic circuitry which acquires some or all of the data required by the remote monitoring system of the invention. In such a case, it is only necessary to connect the electronic circuitry of the vending machine with the input/output and/or expansion ports of an appropriate interface.

A main power module can be connected to the available power source for the vending machine for operation. When a remote monitoring system detects a problem with the vending machine, data indicating the type of problem, such as a malfunction or depletion of inventory, can be communicated to the appropriate source for action. This allows service personnel to be dispatched promptly when they are required. Moreover, with appropriate equipment, information about the cause of the problem can be communicated to service personnel to provide them

with an idea of the situation that needs to be addressed. Thus, the vending machine can be promptly serviced, when required, and unnecessary visits to the vending machine can be eliminated.

The invention is also suitable for monitoring drop boxes used by various delivery services (*e.g.*, USPS, FedEx, UPS, *etc.*) to monitor the status of the drop box. For example, a remote monitoring system can be employed to determine whether the drop box currently contains any items for delivery and/or whether a particular drop box has been filled to capacity. In this manner, pickup schedules for certain drop boxes can be altered to avoid sending personnel to an empty drop box and/or to immediately send personnel to a full drop box. Conventional sensing devices can be employed to detect the presence of an item in the box or to detect the condition that the box is full. The monitoring system for a particular drop box may be manually or automatically reset each time the box is emptied.

The invention is also suitable for monitoring various aspects of sewer and water treatment facilities. For example, sensors can be employed to monitor the chemical composition of the outlet stream of sewer and water treatment facilities to determine whether a malfunction has occurred. Alternatively, key apparatus or process parameters can be remotely monitored including system pressure, power supply, the operational status of pumps, feed devices, purifiers, etc. Moreover, the invention can be interfaced with one or more control devices to permit not only remote monitoring of the system but also remote adjustment of certain parameters

of the system responsive to the data collected by the remote monitoring operation. Such parameters as flow rate, system pressure, feed rate of chemical additives, among others, may be remotely adjusted using the invention. This permits not only the ability to remotely diagnose problems, but also the ability to remotely correct some of the problems.

The invention is also applicable to the monitoring of flood control systems and/or the collection of data required for proper operation of such flood control systems. More specifically, the invention can be employed, for example, to monitor the water level in various bodies of water to provide indications of dangerous flood conditions and to collect the data required to react to such conditions. The invention can also be employed to monitor and adjust various types of flood control systems including gates, dams, and other water control devices. Flow rates can be monitored using conventional flow sensors and, based on collected data, remote adjustments can be made to open or close flood gates, as necessary, to react to dangerous flood conditions. The invention is particularly advantageous for such applications since for flood control, it is usually necessary to monitor conditions in remote locations which would otherwise be impracticable using conventional means.

Another advantageous application of the invention is for the monitoring of various aspects of railroad transportation systems. The remote monitoring system can be employed to detect malfunctions such as track switch failure, road crossing

equipment failure, as well as various parameters of individual rail cars such as refrigeration equipment, hazardous cargo leaks, among other things. The remote monitoring system of the invention can also be used to track particular rail cars and/or inventory, to monitor railroad traffic patterns and to implement collision avoidance systems. Again, due to the flexibility of the system of the invention, it is particularly suited for mounting on rail cars and/or at remote locations since it can take advantage of whatever communication system may be available to it at a particular location and/or switch among different communication systems, as required.

The invention may also be employed as part of a waste management system to monitor such things as the need for pick-up at a particular dumpster, the truck count at a dumpster and/or to determine whether a particular truck is full and needs to unload. In this manner, trucks can be more efficiently deployed to make pick-ups where needed and to avoid unnecessary pick ups. This may permit a reduction in the number of trucks required to service a particular area and/or allow alterations of the size or placement of dumpsters to efficiently accommodate the need for same.

The invention is also suitable for deployment as part of an environmental management system. For example, regulatory agencies could employ the invention to monitor the operation of key pollution control equipment, or important waste streams from industrial facilities to provide early warning of hazardous waste spills.

Also, water supplies can be remotely monitored to detect changes in the water composition.

Yet another application of the invention is in the monitoring of oil and gas pipelines. The remote monitoring system can be employed to monitor flow rates, important pipeline equipment and system pressure. Also, the system can be used for valve control or to monitor and adjust conditions at the well head responsive to collected data or supply and demand considerations. Further, the remote monitoring system can be employed as a security device to detect signs that that pipeline system has been tampered with in some manner. The invention in another regard may be deployed in the extraction phase of oil, gas or other wells to monitor well heads for flow rates, temperatures and other parameters on operating wells. The invention may also be employed in the monitoring of downhole data analysis in oil, gas and other facilities, for instance to measure temperature, pressure, flow rates, depth readings and other parameters.

A still further application of the invention is in the field of traffic monitoring and/or control. The system can be employed, for example, to count vehicles and collect data for analysis of traffic patterns. Also, the system can be employed to provide indications that theaters, stadiums, parking lots and other public places have reached their full capacity.

The invention is also applicable to monitor various aspects of utilities including gas, electric and water utilities. For example, the meters in individual

households can be replaced by, or upgraded with the invention to provide remote reporting of utility usage to a data collection center. Further, water, gas and electricity distribution systems can be monitored using the invention for both failure detection and to collect data useful to determine efficient ways to operate such distribution systems. Additionally, a variety of different key pieces of equipment employed by utilities can be monitored using the system of the invention.

In the medical field, devices which monitor heartbeat, blood sugar concentration and other important parameters, can employ the system of the invention to alert the patient and the doctor, paramedic or hospital to a dangerous condition.

Additionally, the remote monitoring device of the invention is particularly suitable for quality management. Specifically, various parameters of manufacturing processes can be remotely monitored to ensure quality and/or adherence to certain manufacturing practices. The present system may be used by licensor's to ensure compliance with one or more licensing conditions by a plurality of licensees from a single, central data collection center. Such things as compliance with quality control standards, number of units produced, operation of manufacturing equipment within predetermined tolerances, etc. can be monitored using the system of the invention.

The system of the invention is also applicable to various data mining applications. For example, by monitoring the appropriate sources an individual could employ the system to obtain notification when a certain stock reaches a predetermined price (*e.g.*, by monitoring NYSE price ticker data). Additionally, the invention can be employed to monitor news wires, broadcast stations and other media sources and notify when a certain announcement or condition occurs (*e.g.*, press release is announced, legislation is passed, court decision is announced, litigation is filed, corporation is mentioned in a news article, *etc.*).

Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. The specification and examples should be considered exemplary only.

What is claimed is:

1. A system for managing a virtual network, comprising:

a first interface to a remote sensing platform, the remote sensing platform sensing status information of at least one operational device;

a second interface to at least one client platform, the at least one client platform operable to present the status information of the at least one operational device; and

a mediation server, communicating with the first interface and the second interface, the mediation server translating the status information of the at least one operational device from a first format to a second format for presentation via the at least one client platform.

2. The system of claim 1, wherein the at least one operational device comprises a plurality of operational devices.

3. The system of claim 1, wherein the at least one operational device comprises at least one of a power device, a generator device, a gate access device, a water flow device, an aerial tower light device, a vending machine device, a drop box device, a sewer device, a water treatment device, a flood control device, a railroad device, a waste management device, an environmental management device, a pipeline device, a wellhead device, a downhole device, a traffic device, a gas line

device, a medical device, a financial information device, an inventory tracking device, an other utility device, and a quality management device.

4. The system of claim 1, wherein the first interface comprises a low-level representation of the at least one operational device.

5. The system of claim 1, wherein the low-level representation comprises a graphical representation of the at least one operational device and operating data.

6. The system of claim 1, wherein the second interface comprises a graphical user interface displaying the status information.

7. The system of claim 1, wherein the second interface comprises an Internet connection.

8. The system of claim 1, wherein the second interface comprises an input module for inputting commands via the second interface.

9. The system of claim 8, wherein the commands comprise at least one of display commands selecting status information to display via the second

interface, and operational commands to communicate to the at least one operational device.

10. The system of claim 1, wherein the remote sensing platform comprises at least one remote network connected to the at least one operational device.

11. The system of claim 10, wherein the at least one remote network comprises a wireless network.

12. The system of claim 11, wherein the wireless network comprises at least one of a Cellemetry interface, a MicroBurst interface, a Mobitex interface, an OrbComm interface, a RIM interface, a GSM interface, a GPS interface, a Bluetooth interface, a LEO satellite interface, a GEO satellite interface, a CDMA interface, a TDMA interface, an IEEE 802.11b interface, and a HyperLAN II interface.

13. The system of claim 10, wherein the at least one remote network comprises a wired network.

14. The system of claim 13, wherein the wired network comprises at least one of a ModBus interface, a VMEBus interface, a Metrum-Datatape itnterface, an RS-232 interface and a GPIB interface.

15. The system of claim 10, wherein the at least one remote network comprises a plurality of remote networks.

16. The system of claim 15, wherein the at least one operational device comprises a plurality of operational devices, and each of the plurality of remote networks senses the status information of at least a corresponding one of the operational devices.

17. The system of claim 16, wherein the operational devices are of the same type.

18. The system of claim 16, wherein at least two of the operational devices are of a different type.

19. The system of claim 1, wherein the mediation server comprises a database, the database storing information related to the at least one operational device.

20. The system of claim 19, wherein the information stored in the database comprises an operational history of the at least one operational device.

21. The system of claim 20, wherein the database is queryable via at least one of the first interface and the second interface.

22. The system of claim 1, wherein the client comprises at least one of a computer and a wireless remote device.

23. The system of claim 1, wherein the second interface comprises a Web page.

24. The system of claim 23, wherein the Web page comprises an account login.

25. The system of claim 1, wherein the translation server generates a notification when alert criteria are satisfied in the status information.

26. The system of claim 25, wherein the notification comprises at least one of landline telephonic notification, wireless telephonic notification, email

notification, pager notification, instant messaging notification and PDA notification.

27. The system of claim 1, wherein the mediation server comprises a redundant device for failure recovery.

28. A method for managing a virtual network, comprising:

a) sensing status information of at least one operational device via a remote sensing platform;

b) interfacing to at least one client platform, the at least one client platform operable to present the status information of the at least one operational device; and

c) translating the status information of the at least one operational device from a first format to a second format for presentation via the at least one client platform.

29. The method of claim 28, wherein the at least one operational device comprises a plurality of operational devices.

30. The method of claim 28, wherein the at least one operational device comprises at least one of a power device, a generator device, a gate access device, a

water flow device, an aerial tower light device, a vending machine device, a drop box device, a sewer device, a water treatment device, a flood control device, a railroad device, a waste management device, an environmental management device, a pipeline device, a wellhead device, a downhole device, a traffic device, a gas line device, a medical device, a financial information device, an inventory tracking device, an other utility device, and a quality management device.

31. The method of claim 28, further comprising a step of (d) generating a low-level representation of the at least one operational device.

32. The method of claim 31, wherein the step (d) of generating a low-level representation comprises a step (e) of generating a graphical representation of the at least one operational device and operating data.

33. The method of claim 28, further comprising a step of (f) generating a graphical user interface displaying the status information.

34. The method of claim 28, wherein the step (b) of interfacing comprises a step (g) of establishing an Internet connection.

35. The method of claim 28, wherein the step (b) of interfacing comprises a step (h) of generating an input module for inputting commands.

36. The method of claim 35, wherein the commands comprise at least one of display commands selecting status information to display via the second interface, and operational commands to communicate to the at least one operational device.

37. The method of claim 28, wherein the remote sensing platform comprises at least one remote network connected to the at least one operational device.

38. The method of claim 37, wherein the at least one remote network comprises a wireless network.

39. The method of claim 38, wherein the wireless network comprises at least one of a Cellemetry interface, a MicroBurst interface, a Mobitex interface, an OrbComm interface, a RIM interface, a GSM interface, a GPS interface, a Bluetooth interface, a LEO satellite interface, a GEO satellite interface, a CDMA interface, a TDMA interface, an IEEE 802.11b interface, and a HyperLAN II interface.

40. The method of claim 37, wherein the at least one remote network comprises a wired network.

41. The method of claim 40, wherein the wired network comprises at least one of a ModBus interface, a VMEBus interface, a Metrum-Datatape itnterface, an RS-232 interface and a GPIB interface.

42. The method of claim 37, wherein the at least one remote network comprises a plurality of remote networks.

43. The method of claim 42, wherein the at least one operational device comprises a plurality of operational devices, and the step (a) of sensing comprises a step (i) of sensing in each of the plurality of remote networks the status information of at least a corresponding one of the operational devices.

44. The method of claim 43, wherein the operational devices are of the same type.

45. The method of claim 43, wherein at least two of the operational devices are of a different type.

46. The method of claim 28, further comprising a step of (j) storing information related to the at least one operational device in a database.

47. The method of claim 46, wherein the step (j) of storing comprises a step (k) of storing comprises an operational history of the at least one operational device in the database.

48. The method of claim 47, further comprising a step of (l) querying the database.

49. The method of claim 28, wherein the client platform comprises at least one of a computer and a wireless remote device.

50. The method of claim 28, wherein the step (b) of interfacing comprises a step (m) of interfacing to a Web page.

51. The method of claim 50, further comprising a step of (n) performing an account login.

52. The method of claim 28, further comprising a step of (o) generating a notification when alert criteria are satisfied in the status information.

53. The method of claim 52, wherein the step (p) of generating a notification comprises a step (q) of generating at least one of landline telephonic notification, wireless telephonic notification, email notification, pager notification, instant messaging notification, and PDA notification.

54. The method of claim 28, further comprising a step of (r) providing a redundant device for failure recovery.

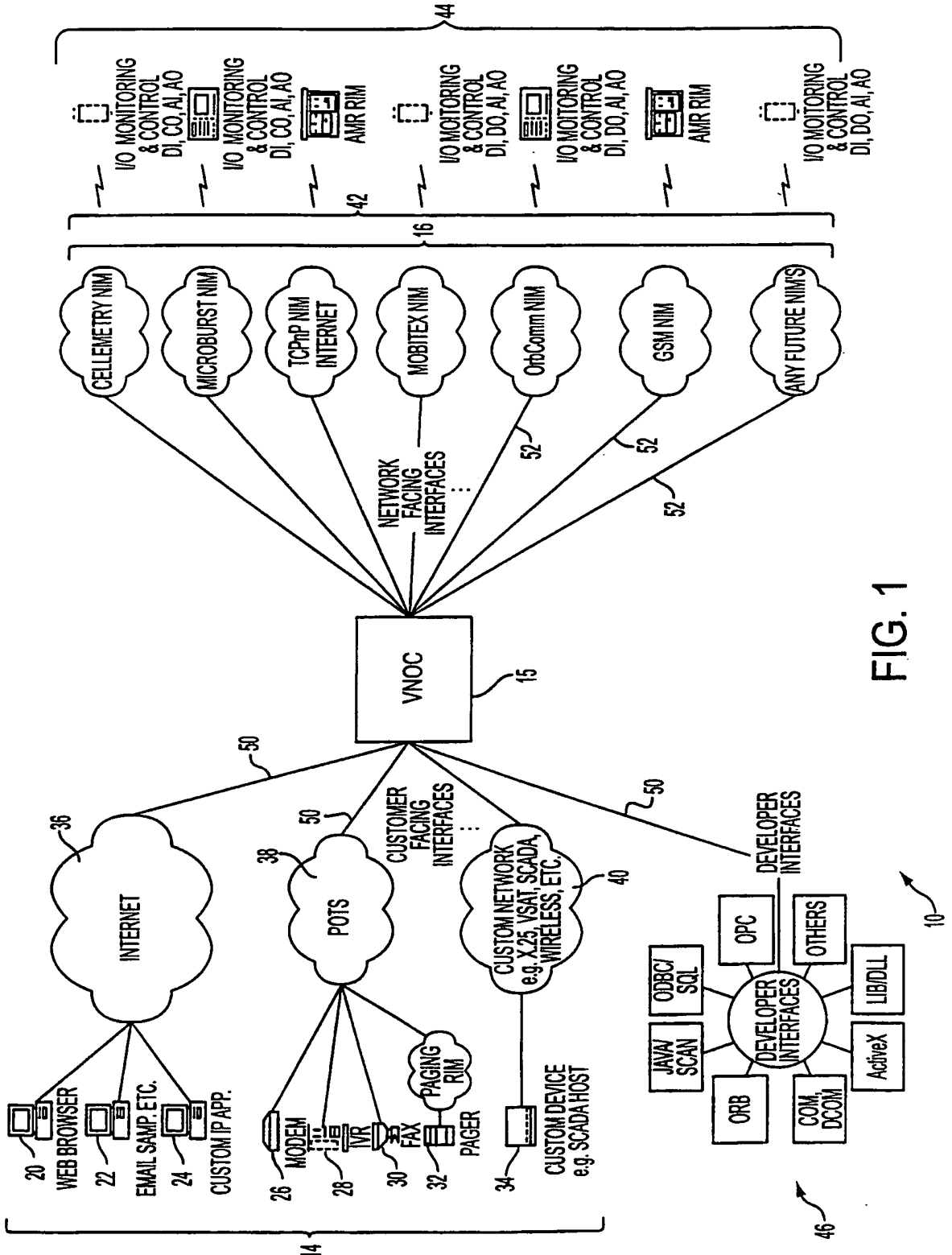
44
I/O MONITORING & CONTROL DI, CO, AI, AO
I/O MONITORING & CONTROL DI, CO, AI, AO
AMR RIM
I/O MONITORING & CONTROL DI, DO, AI, AO
I/O MONITORING & CONTROL DI, DO, AI, AO
AMR RIM
I/O MONITORING & CONTROL DI, DO, AI, AO
42
16
CELLEMETRY NIM
MICROBURST NIM
TCP/IP NIM INTERNET
MOBITEX NIM
OrbComm NIM
GSM NIM
ANY FUTURE NIM'S
NETWORK FACING INTERFACES
52
VNOC
15
50
INTERNET
36
POTS
38
CUSTOMER FACING INTERFACES
CUSTOM NETWORK e.g. X.25, VSAT, SCADA, WIRELESS, ETC.
40
DEVELOPER INTERFACES
WEB BROWSER
20
EMAIL SAMP, ETC.
22
CUSTOM IP APP.
24
MODEM
26
IVR
28
FAX
30
PAGING RIM
PAGER
32
CUSTOM DEVICE e.g. SCADA HOST
34
14
OPC
OTHERS
ODBC/ SQL
JAVA/ SCAN
DEVELOPER INTERFACES
LIB/DLL
ActiveX
ORB
COM, DCOM
46
10

FIG. 1

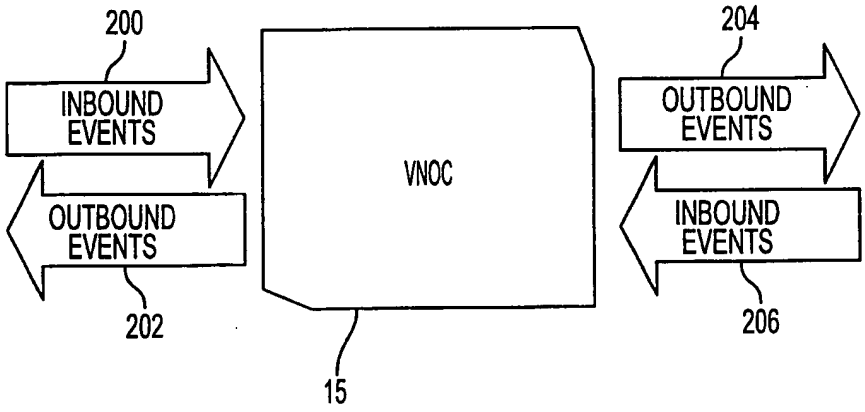
200
INBOUND EVENTS
OUTBOUND EVENTS
202
VNOC
15
204
OUTBOUND EVENTS
INBOUND EVENTS
206

FIG. 2

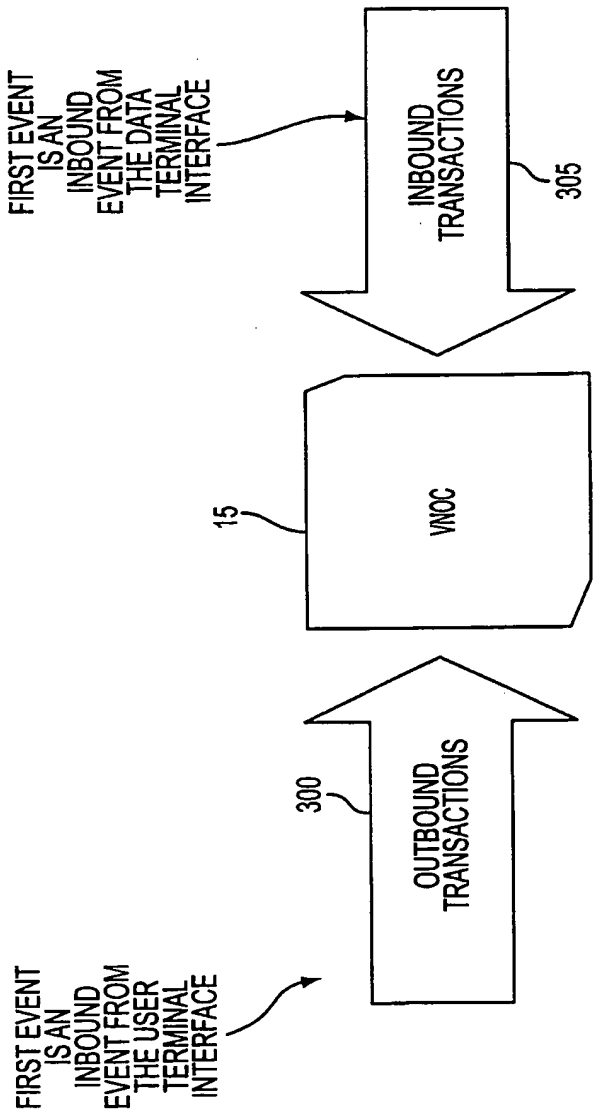
FIRST EVENT IS AN INBOUND EVENT FROM THE DATA TERMINAL INTERFACE
INBOUND TRANSACTIONS
305
15
VNOC
300
OUTBOUND TRANSACTIONS
FIRST EVENT IS AN INBOUND EVENT FROM THE USER TERMINAL INTERFACE

FIG. 3

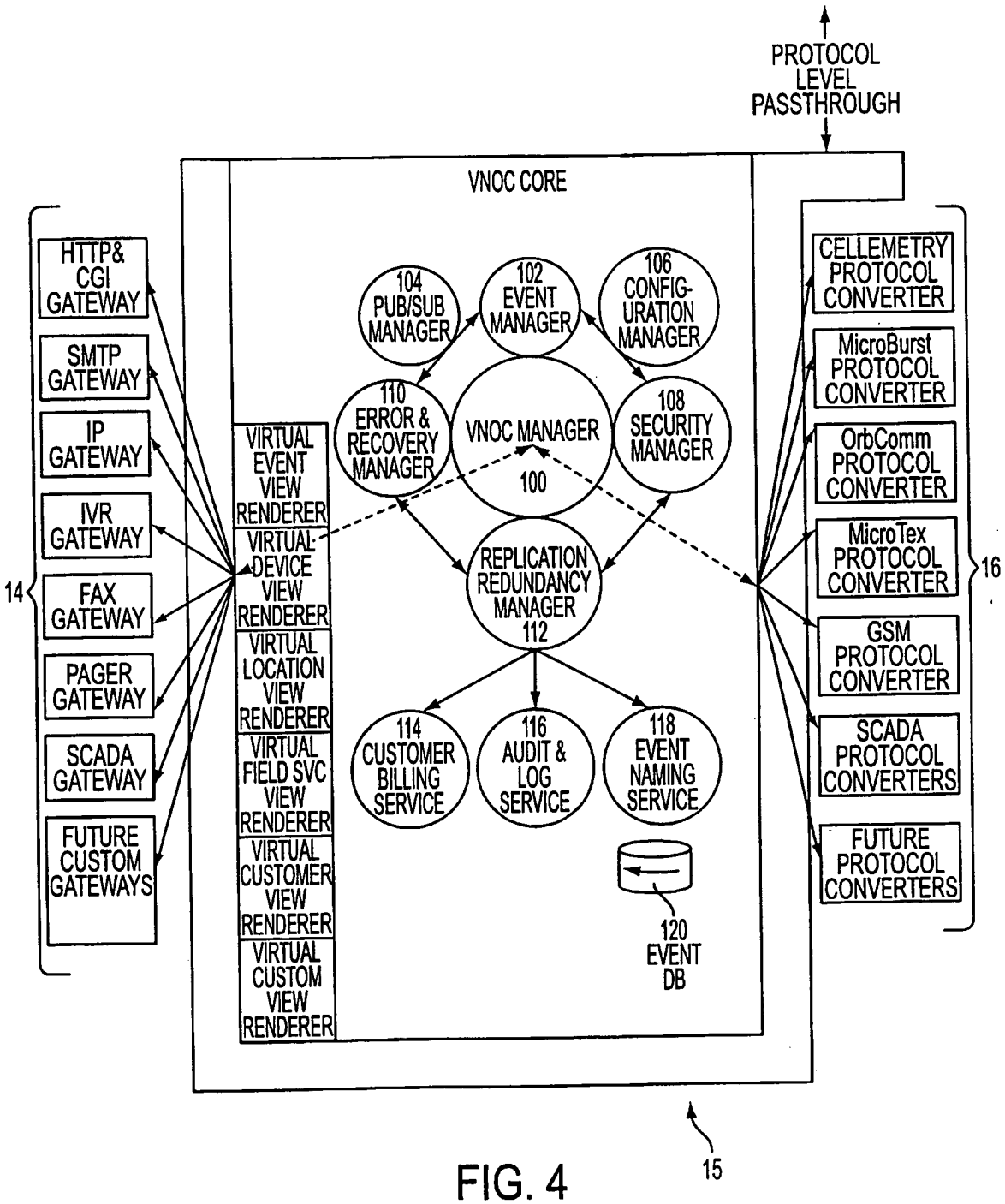
PROTOCOL LEVEL PASSTHROUGH
VNOC CORE
HTTP& CGI GATEWAY
SMTP GATEWAY
IP GATEWAY
IVR GATEWAY
FAX GATEWAY
PAGER GATEWAY
SCADA GATEWAY
FUTURE CUSTOM GATEWAYS
14
VIRTUAL EVENT VIEW RENDERER
VIRTUAL DEVICE VIEW RENDERER
VIRTUAL LOCATION VIEW RENDERER
VIRTUAL FIELD SVC VIEW RENDERER
VIRTUAL CUSTOMER VIEW RENDERER
VIRTUAL CUSTOM VIEW RENDERER
104 PUB/SUB MANAGER
102 EVENT MANAGER
106 CONFIG-URATION MANAGER
110 ERROR & RECOVERY MANAGER
VNOC MANAGER 100
108 SECURITY MANAGER
REPLICATION REDUNDANCY MANAGER 112
114 CUSTOMER BILLING SERVICE
116 AUDIT & LOG SERVICE
118 EVENT NAMING SERVICE
120 EVENT DB
CELLEMETRY PROTOCOL CONVERTER
MicroBurst PROTOCOL CONVERTER
OrbComm PROTOCOL CONVERTER
MicroTex PROTOCOL CONVERTER
GSM PROTOCOL CONVERTER
SCADA PROTOCOL CONVERTERS
FUTURE PROTOCOL CONVERTERS
16
15

FIG. 4

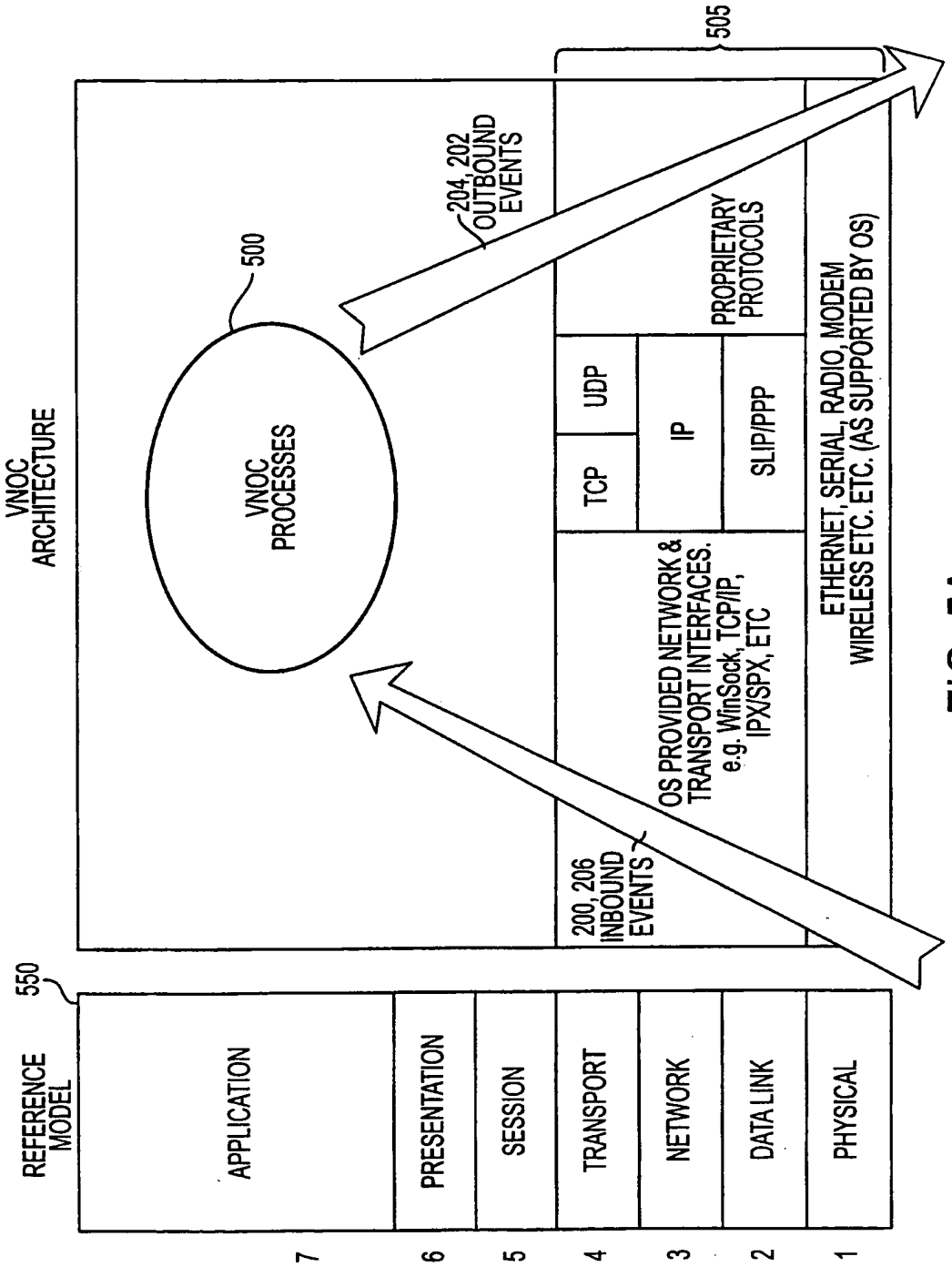
505
204, 202
OUTBOUND
EVENTS
500
VNOC
PROCESSES
VNOC
ARCHITECTURE
PROPRIETARY
PROTOCOLS
UDP
TCP
IP
SLIP/PPP
OS PROVIDED NETWORK &
TRANSPORT INTERFACES.
e.g. WinSock, TCP/IP,
IPX/SPX, ETC
ETHERNET, SERIAL, RADIO, MODEM
WIRELESS ETC. ETC. (AS SUPPORTED BY OS)
200, 206
INBOUND
EVENTS
550
REFERENCE
MODEL
APPLICATION
PRESENTATION
SESSION
TRANSPORT
NETWORK
DATA LINK
PHYSICAL
7
6
5
4
3
2
1

FIG. 5A

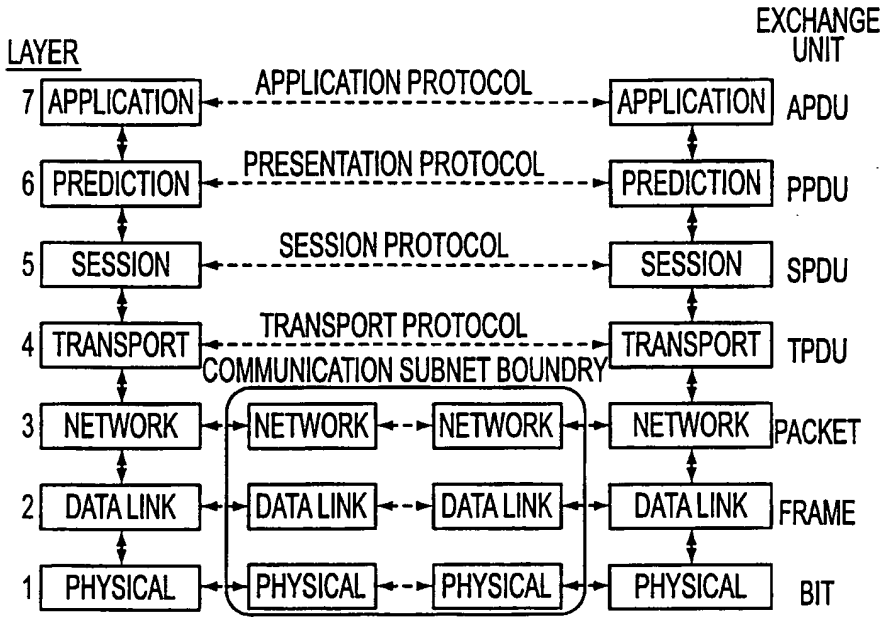
LAYER
EXCHANGE UNIT
7 APPLICATION
APPLICATION PROTOCOL
APPLICATION
APDU
6 PREDICTION
PRESENTATION PROTOCOL
PREDICTION
PPDU
5 SESSION
SESSION PROTOCOL
SESSION
SPDU
4 TRANSPORT
TRANSPORT PROTOCOL
TRANSPORT
TPDU
COMMUNICATION SUBNET BOUNDRY
3 NETWORK
NETWORK
NETWORK
NETWORK
PACKET
2 DATA LINK
DATA LINK
DATA LINK
DATA LINK
FRAME
1 PHYSICAL
PHYSICAL
PHYSICAL
PHYSICAL
BIT

FIG. 5B

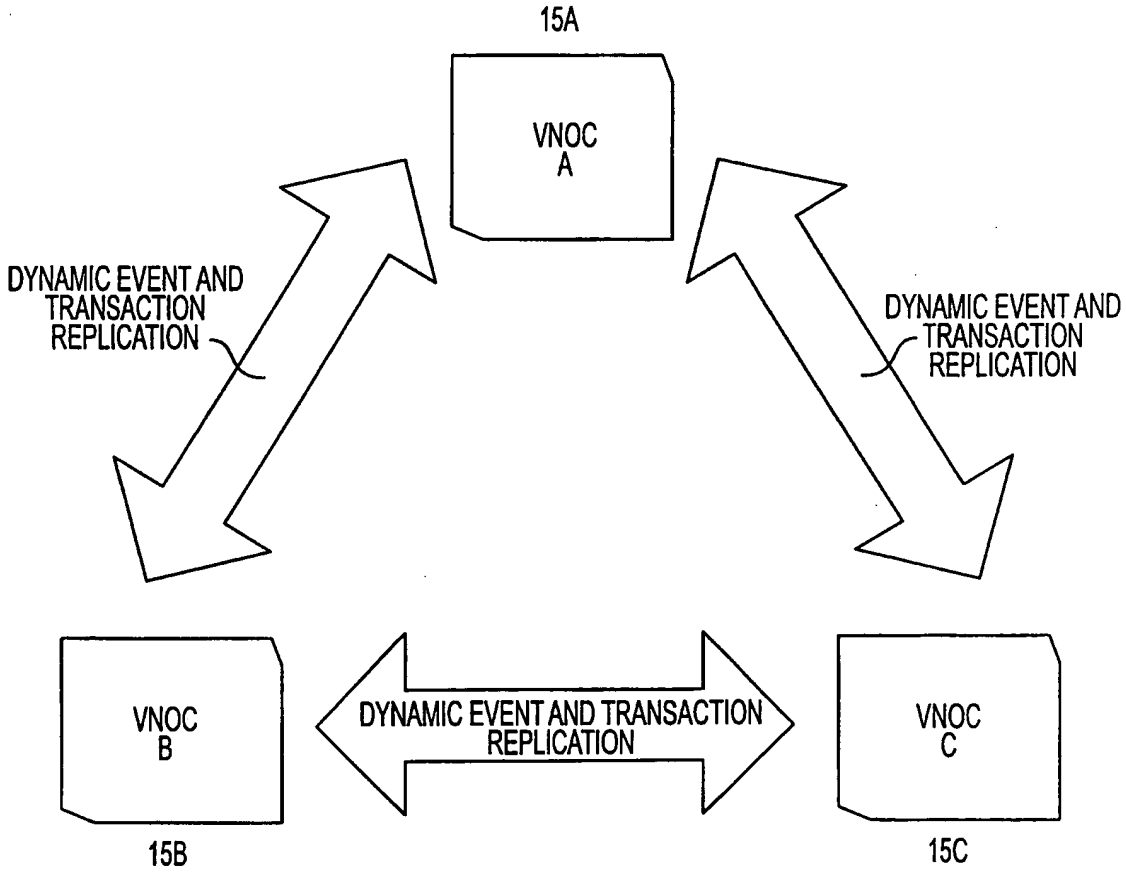
15A
VNOC
A
DYNAMIC EVENT AND
TRANSACTION
REPLICATION
DYNAMIC EVENT AND
TRANSACTION
REPLICATION
VNOC
B
DYNAMIC EVENT AND TRANSACTION
REPLICATION
VNOC
C
15B
15C

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/19846

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04M 11/00; G06F 15/16
US CL : 379/106.01; 709/202, 217, 227

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/106.01; 709/202, 217, 227

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EAST
search terms: telemetry internet web meter

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,909,493 A (MOTOYAMA) 01 JUNE 1999, col. 2, lines 9-53, col. 6, line 6 - col. 8, line 45.	1-54
Y	US 5,905,784 A (GARLAND et al) 18 MAY 1999, col. 2, lines 36-67.	1-54
Y	US 3,900,842 A (CALABRO et al) 19 AUGUST 1975, col. 1, line 5 - col. 2, line 54.	1-54

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
11 SEPTEMBER 2000	18 DEC 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer PAUL KANG James R. Matthews Telephone No. (703) 305-9000

Form PCT/ISA/210 (second sheet) (July 1998)*